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# Commercial Growing and Harvesting of SWEETPOTATOES



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U. S. DEPARTMENT OF AGRICULTURE

ACREAGE, production, and per capita consumption of sweetpotatoes have been gradually declining in the United States for many years. Production and handling of the crop require a relatively large amount of man labor because adequate labor-saving machines have not been developed. High labor requirements tend to discourage farmers from growing the crop and contribute to high prices to consumers. Average yields per acre remain low. If the best known methods are used to produce high yields, sweetpotatoes can become a much more profitable crop than it has been generally in recent years, despite its low degree of mechanization.

The surest ways of increasing average yields and decreasing costs of production are for growers to—

1. Grow the crop on a well-drained sandy loam, fine sandy loam, or loamy fine sand.
2. Grow cover crops and apply 1,000 to 1,500 pounds of fertilizer per acre, about half of it mixed under the ridge and half as a top dressing on the ridge 3 weeks after transplanting.
3. Bed 10 to 12 bushels of seed stock for each acre to be transplanted, to get enough early plants.
4. Transplant the crop as soon as the weather is warm enough.
5. Keep labor costs down by using the most modern equipment with adequate horse or tractor power.
6. Keep diseases under control by sanitation, careful seed selection, seed treatment, and growing sweetpotatoes on any one field only once in 4 or 5 years.

Losses after harvest can be reduced and the value of the crop increased by—

1. Harvesting at or before the first killing frost and in good weather.
2. Handling with the least injury feasible.
3. Curing and storing in a suitable storage house promptly and properly after harvest.

This bulletin supersedes Farmers' Bulletin 999, Sweetpotato Growing. It was prepared mainly for those interested in the production of sweetpotatoes on a commercial scale. The principles and practices described, however, can be easily adapted to small-scale production for home use. Except for the use of power machinery, the methods apply equally well to growing for either home or commercial use.

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# COMMERCIAL GROWING AND HARVESTING OF SWEETPOTATOES

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## RECENT HISTORY AND STATUS OF THE SWEETPOTATO CROP

### PRODUCTION AND VALUE

The acreage planted to sweetpotatoes in the United States has varied from some 550,000 acres at the turn of the century to a maximum of about 1,060,000 acres in the bad depression year of 1932. Acreage and production have declined generally from that year onward. Acreage in the late 1940's was roughly equal to that of 50 years before, and production was but little higher—around 55 million bushels. The largest crop was grown in 1932, nearly 87 million bushels.

The total farm value of the sweetpotato crop has fluctuated widely, not only with annual production but as prices of farm products have changed. Farm price per bushel has varied from a low of $0.47 in 1932 to $2.18 in 1946. The greatest farm value of the total crop was realized during the war year of 1943, when 71 million bushels from 857,000 acres were valued at $146,000,000. From 1945 to 1949 the value of the crop ranged from about $110,000,000 to $145,000,000.

For generations the sweetpotato was the second most important vegetable crop of this country, exceeded only by the white, or Irish, potato. In the 1940's, however, the acreage and farm value of sweetpotatoes fell below the acreage and value of tomatoes. Commercial sweetpotato production declined in this country for several reasons, among them: (1) The consumption of all starchy foods, per capita, is decreasing because other foods are more generally available and also because the average American requires less starchy food now than in the days when more physical labor was necessary. (2) The growing of sweetpotatoes has not become so highly mechanized as has the growing of many other farm crops. It requires relatively more hand labor and has therefore become less attractive as a farm enterprise. In many situations the necessary hand labor is no longer available at costs that the farmer can afford to pay in comparison with the value of labor for growing other crops. (3) Retail prices of sweetpotatoes have increased to such levels in many areas that the sales volume has declined. (4) High losses from rots and breakdown after purchase add further to the cost and tend to discourage buyers.

## FOOD USES

By far the greatest proportion of the sweetpotato crop is obtained by the consumer, for food, in the unprocessed state. Less than half the crop, however, ever reaches retail stores. About a third of the total crop is used for food on the farms where grown.

In accord with the modern trend with many other foods, there is an increase in the buying of canned sweetpotatoes. Although sweetpotatoes are canned less extensively than tomatoes, corn, peas, and a dozen other common vegetables, consumers are learning the merits of a high-quality canned product. In recent years about 1¾ to 4 million cases have been canned annually.

During World War II large tonnages of sweetpotatoes were dehydrated and sealed in airtight containers for shipment overseas. A quite acceptable product can be prepared by dehydration by modern methods, but because it is relatively expensive it is unlikely to become popular with the average consumer.

Methods have been developed for preparing frozen, cooked sweetpotato pulp, or puree, but as yet (1950) this product has not become important commercially.

The outstanding value of the sweetpotato as a food is too little appreciated. Pound for pound, it contains about 50 percent more fuel value (calories) than the white potato. Varieties with deeply orange-colored flesh are among the richest sources of carotene, or provitamin A; and the sweetpotato compares favorably with the tomato as a source of vitamin C. The carbohydrate and protein contents of cooked sweetpotato are rather similar to those of cooked, polished rice, but the sweetpotato has the marked advantage of having a high content of vitamins A (orange-fleshed varieties) and C.

## NONFOOD USES

About 5 percent of the total crop is stored for "seed" the following year. About 15 to 20 percent is fed to livestock or in part lost through spoilage or other forms of waste. Until the early 1940's sweetpotatoes that were fed to livestock were fed in the raw, completely unprocessed form. Since that time a small number of dehydrating plants have

been built in the lower South for the preparation of stock feed from cull sweetpotatoes and other low-cost materials that will produce a good feedstuff upon chopping and drying.

On many soils of the South where the growing season is long enough to permit transplanting of sweetpotatoes in April more carbohydrate feed can be grown as an acre of sweetpotatoes than as an acre of corn or any other crop. Recent improvements in corn varieties (hybrids), in closer spacing, in the fertilizing of corn, and in the mechanization of its production (which lowers man-labor requirements) have largely reduced the possible advantages of sweetpotatoes over corn as stock feed. Unless costs of producing sweetpotatoes can be reduced through more effective farm machinery and cheaper propagation, it is unlikely that sweetpotatoes will displace corn as stock feed to any important degree.

Even though costs of growing and harvesting may be markedly reduced, sweetpotatoes as stock feed present serious handling and storage problems because of their bulkiness, high water content, and susceptibility to spoilage. The State agricultural experiment stations of Alabama and Texas have developed low-cost farm methods of chopping or shredding sweetpotatoes for natural drying so that the crop can be stored safely for feed in an ordinary barn. Artificial drying is faster than natural drying and is free of weather hazards, but facilities for such drying are now unavailable to most growers. Furthermore, they appear to be feasible only in districts having an abundance of cheap fuel and for farmers relatively near the drying plant.

The prospects for a sweetpotato-starch industry in the South in the late 1930's and early 1940's failed to materialize. The manufacturing problems have been satisfactorily solved, but farmers cannot now afford to grow sweetpotatoes for starch manufacture at a price to compete with other sources of starch—either foreign or domestic. Waxy corn and waxy sorghum contain starches similar to those of the sweetpotato and can now meet our needs for such starches. Those crops can be grown and handled by entirely mechanized methods far more cheaply for starch than the sweetpotato can be, and the grain can be easily handled and stored for long periods.

For the immediate future at least, it appears that the sweetpotato will remain commercially important almost entirely as a crop for human food.

## CLIMATIC AND SOIL REQUIREMENTS

### CLIMATIC REQUIREMENTS

The climatic requirements of the sweetpotato may best be indicated by simply pointing out the parts of this country where it is most commonly grown. Each dot on the map in figure 1 represents 500 acres of sweetpotatoes and the approximate location of such acreage in 1944. To obtain good yields profitably by the methods usually followed in this country, there should be an average frost-free growing season of at least 5 months and a surely frost-free season of 4 months. Mere freedom from frost, however, is not enough. The days and nights must be fairly warm, since the sweetpotato is a tropical plant and will not thrive during chilly weather even though it is safe enough from frost.

Recent studies by this Department in cooperation with several State agricultural experiment stations showed that on mineral soils the farther South the plant is grown, the higher in solids and richer in starch the roots will be. Surprisingly, this is true although the crop may grow in the field no longer in the southern part than in the northern part of the sweetpotato region, and the average yields of roots may be no higher in the South.

With the longer growing season in the South it is possible to produce higher average yields than in the North if other conditions are equally favorable. Unfortunately, however, most southern growers do not take full advantage of the more favorable climate, with the result that the average yields in the Gulf States are lower than those in the Middle Atlantic States.

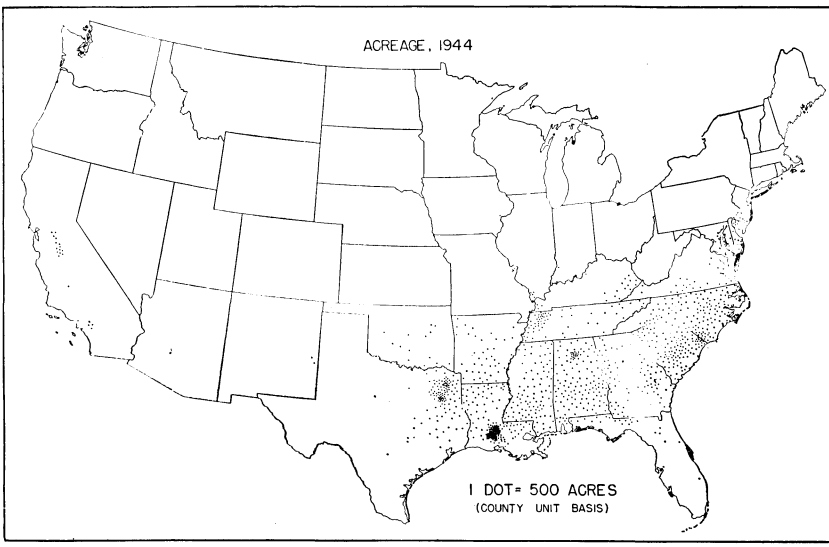


*Figure 1.*—**Distribution of acreage of sweetpotatoes in the United States in 1944. (Adapted from the Bureau of the Census, U. S. Department of Commerce.)**

Few sweetpotatoes are grown in the West under irrigation. Most of the crop is grown in areas receiving 40 inches of rainfall or more annually, and very few are grown in districts receiving less than 35 inches, unless irrigated. More important than the annual rainfall is the growing-season rainfall, which should be well distributed over the season at an average rate of about an inch or a little more per week until 2 or 3 weeks before harvest and then at about half that rate. In addition to the inch-per-week requirement during the growing season, the soil should of course be well supplied with water from winter or early-spring rains.

The sweetpotato is fairly drought-tolerant in that it can survive some rather long dry spells during the summer after growth is well along and resume more active growth when adequate rains fall again; the roots often crack badly under such conditions. The sweetpotato is not, however, to be considered a dry-weather crop. Although it can survive some drought with little evident damage, yields are seriously reduced. Low water supply also impairs the quality of the crop. In

very dry years the roots have lower total-solids and starch contents and higher water content than they have in normal or wet years. This may seem the opposite of what might be expected. Apparently, in very dry weather the plants are unable to manufacture and to store in the roots the amounts of starch and other solids that are normal for the respective varieties.

### SOILS FOR SWEETPOTATOES

Contrary to a common belief the sweetpotato is not a poor-land crop. There probably is no such crop. While it is true that the sweetpotato produces more desirable sizes and shapes of roots on certain soils of medium to light texture than on heavy soils, it can produce profitable yields only on soils of good fertility—either natural or added in the form of manures and fertilizers.

The majority of soils that are rated good to excellent for sweetpotato growing consist of certain moderately deep, very friable fine sandy loams, sandy loams, or loamy fine sands. Not all such soils, however, are satisfactory. The soil must be well drained. To be rated good or excellent, such surface soils as those just named should be underlain by firm but friable subsoils of heavier character such as clay loams or sandy clay loams. Sandy or gravelly subsoils are too low in fertility and moisture-holding capacity. Roots grown on such soils often penetrate so deeply that they are harvested with difficulty and considerable injury. Subsoils of clay are satisfactory unless they are of a very tight, sticky nature that interferes with water supply and drainage. Poor internal drainage of such soils is likely to cause an excessive amount of cracking of the sweetpotatoes during wet periods.

Excellent sweetpotato soils have surface layers more than a foot in depth, while those of a 6- to 12-inch depth are considered only good. Slopes should be gentle, with little tendency to become eroded.

Heavy, river-bottom soils and other silty or clay surface soils are generally unsatisfactory because they produce roots of poor quality, poor yield, or both. Some friable, well-drained loams and silt loams, however, are highly productive. There is much injury to the sweetpotatoes in harvesting from very heavy soils and excessive amounts of soil adhere to the roots to be marketed or stored. The rich, heavy black prairie soils are undesirable because they produce excessive vine growth and roots of poor shape, although total yields may be relatively high.

### VARIETIES

Sweetpotato varieties may be grouped into food and feed types. The food type may be further divided into two groups: (1) the so-called "dry-fleshed" and (2) the so-called "moist-fleshed" varieties. The "moist-fleshed" varieties are popularly but erroneously called "yams." The yam is not a kind of sweetpotato, but a quite different plant that produces "tubers" that are hardly similar to the "moist-fleshed" sweetpotatoes.

A strange fact about the "dry" versus "moist" varieties of sweetpotatoes is that the "dry" varieties commonly grown in the United States contain a higher percentage of water than the "moist" varieties do. It would be more accurate to refer to these two groups as "firm" and "soft." It is not higher moisture content that makes the Porto Rico variety softer, after cooking, than the Big-Stem Jersey, but the

character of the solids that it contains. Soft and firm describe the cooked flesh. When raw, the flesh of all varieties is hard.

Varieties of the food type are distinguished from those of the feed type by their more pleasing flavor, texture, and generally more attractive appearance. In the food type some yielding capacity may be sacrificed in favor of these qualities. For feed total yields, high solids, and good keeping quality are much more important than appearance and culinary quality.

## FOOD TYPES

The long list of varieties of sweetpotatoes grown for food in the United States 30 to 40 years ago has shrunk to a very few. Most of those described in publications of this Department issued about 1920 are now not only unimportant but seem to have been lost completely. They have been displaced by the few really good varieties now grown. All of our present commercial varieties are rather highly susceptible to many diseases and therefore need to be replaced by disease-resistant ones. It is reasonable to expect that they will be.

Northern consumers have traditionally preferred the firm-fleshed Jersey type of sweetpotato, while southerners have used the soft-fleshed varieties such as Porto Rico and Nancy Hall. In recent years, however, an increasing proportion of the sweetpotatoes sold in northern markets has been of the soft type.

### Soft-Fleshed Varieties

The Porto Rico variety, including the strain called Unit I Porto Rico, is the most extensively grown soft-fleshed variety. It is not well adapted to the northernmost and westernmost districts in which the crop is grown, but it is the dominant variety in the South. Although this variety (fig. 2) is often undesirably irregular in shape, it is of high eating quality.

Nancy Hall often outyields Porto Rico and generally is less irregular in shape. It is of high quality; but its flesh is mottled golden yellow instead of being orange yellow, and it is even more susceptible to certain diseases than Porto Rico. The difficulties of handling, storing, and marketing without loss are against it. At the same time it remains a popular variety for home use in the South, and it can be grown generally over the sweetpotato region.

Nancy Gold is a deep-orange-fleshed mutation that was found in the Nancy Hall variety in Kansas. Except for its much deeper interior color and slightly darker exterior color, it is similar to Nancy Hall. As a variety with soft, orange-colored flesh, it is better adapted to the northerly districts of the Middle Atlantic area and the western districts of the Middle West than is the Porto Rico.

Triumph is less soft and sweet than Porto Rico, but it is not a "dry-fleshed" variety. It is adapted to only the southern half of the sweetpotato region and is grown chiefly for local and home use rather than for distant markets. It is less susceptible to wilt than Porto Rico and Nancy Hall, but it produces fewer sprouts in the plant bed than most other varieties.

The Cliett Bunch Porto Rico, tested and recommended by the Georgia Coastal Plain Experiment Station at Tifton, Ga., is a short-vined mutation of the Porto Rico variety. Except for the length of its

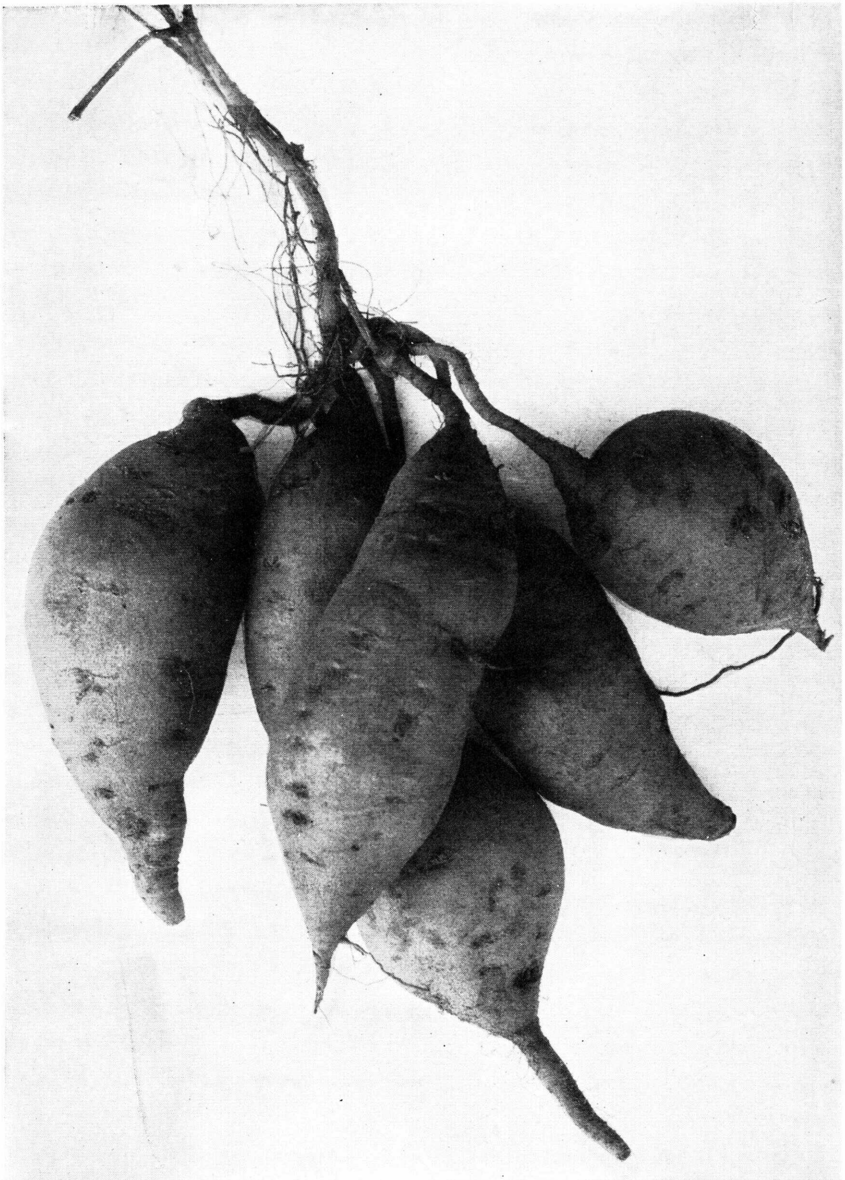

*Figure 2.*—**A hill of Porto Rico sweetpotatoes.**

vines it is similar to Porto Rico. It has as many leaves as Porto Rico, but they are close together on short vines. Because the vines are short, the variety is not so well adapted to the production of vine cuttings for transplanting as the vining type. Some growers like it because the vines are less troublesome than long ones during cultivation and harvest. The Cliett Bunch Porto Rico yields as well as the Porto Rico.

Australian Canner is a new variety obtained by the United States Department of Agriculture a few years ago as an unnamed seedling from the Department of Agriculture of New South Wales, Australia. It was tested widely in the South and introduced for production in this country by the Mississippi Agricultural Experiment Station and the United States Department of Agriculture. It is firmer than most soft, very sweet varieties when cooked, and therefore is especially suited to canning by vacuum-pack methods.

Brief descriptions of the above-named varieties follow.

**Porto Rico.**—Vines medium to long, 5 to 10 feet; stems coarse, internodes short, reddish purple, hairy (especially at the nodes and on the young growth); leaves shouldered, large, green except for purple at base of blade and on veins, slightly hairy on upper surface, smooth below; petioles medium long, 5 to 8 inches, reddish purple, with deeper purple at base of leaf blade, color extending up on veins of lower side of leaf, and at base of petiole. Roots light copper to copper in color, spindle-shaped to globular and irregular in form, surface smooth; flesh orange yellow to salmon; quality excellent.

**Cliett Bunch Porto Rico.**—Same as Porto Rico except that vines average only about 30 inches long at harvesttime.

**Nancy Hall.**—Vines medium in length, 4 to 8 feet; stems green, somewhat hairy; leaves toothed or entire with 4 to 10 low marginal teeth, hairy on upper surface and slightly hairy or smooth beneath, green except for a reddish-purple stain at the juncture of the blade and petiole; petioles slightly hairy, green except at upper end. Roots yellow tinged more or less with salmon, veined or smooth and regular, spindle-shaped, medium in size to large; flesh yellow tinged with salmon; quality excellent.

**Nancy Gold.**—Same as Nancy Hall except that leaves are smooth and roots have buff-colored skin and deep-orange-colored flesh.

**Triumph.**—Vines coarse and vigorous, medium long, 4 to 6 feet, bushy, green; leaves shouldered, large and thick, hairy on veins of upper surface, smooth beneath; leaves and petioles green except for purple stain at base of leaf blade and extending up the veins on the undersurface of the leaf. Roots medium to long, cylindrical in shape, light yellow to russet yellow; flesh light yellow; quality fair to good.

**Australian Canner.**—Vines long, 8 to 12 feet; stems green except for some purple near main stem; leaves medium size, toothed, margins entire, smooth, dark-green upper and light-green lower surface; petioles erect, medium in length and thickness, smooth, green, with purple splash near leaf blade. Roots small to medium, smooth, short-tapered to spindle-shaped, buff-tan skin; flesh salmon; quality very good.

#### Firm-Fleshed Varieties

Since the firm-fleshed Jersey type of sweetpotato has long been grown with more general success than the soft-fleshed type in the more northerly sweetpotato-growing districts, this is the type to which most northern consumers have become accustomed. For the same reason it is the type generally preferred in the North. The most popular varieties of this type have a desirable commercial property—they are relatively more uniform and symmetrical in shape than the principal soft variety. They are more easily packaged for shipment and prepared for attractive display than less shapely varieties. The growth habit of the nicely shaped roots, clustered close to the main stem of the plant, is also attractive to the farmer, because such roots are a little easier to harvest and handle than irregular roots that reach farther away from the stem into the soil.

Despite these advantages of the good Jersey varieties, some of them have their disadvantages. The Maryland Golden, for example, although a very attractive improvement in flesh color over its parent

variety, Big-Stem Jersey, is much inclined to excessive shrinkage in storage. By midwinter it often tends to become pithy. It is difficult to maintain the desired quality during storage and marketing; this causes some loss of popularity, especially among those who grow and store the variety. Maryland Golden is also a poor producer of plants in the bed. Other common varieties of the firm type tend to shrink more in storage than the most popular soft varieties, but less than Maryland Golden.

Until the 1930's the available firm varieties were all much lighter in flesh color than Porto Rico and therefore much lower in carotene content. Since the introduction of Maryland Golden (the first deep-orange-fleshed variety of the Jersey type) by the Maryland Agricultural Experiment Station, several others have been found. Of these Orlis is perhaps the most widely grown. Orlis is a mutation of Little-Stem Jersey (Yellow Jersey) introduced by the Kansas Agricultural Experiment Station. It is grown in New Jersey and adjacent districts under the name of "Jersey Orange." The new strains are somewhat softer fleshed or less "dry" than the parent varieties. It is probable that in a few years all the table varieties with light or yellow flesh will be replaced by new varieties with deep-orange flesh, high in carotene.

Brief descriptions of the principal firm-fleshed varieties, of which Big-Stem Jersey (fig. 3) is fairly typical, follow.

**Big-Stem Jersey.**—Vines moderately large, long, 6 to 12 feet; stems green, hairy; leaves shouldered or entire, hairy above and smooth beneath, green; petioles hairy, green. Roots russet yellow, smooth and regular in their spindle shape, surface veined or smooth, small to large in size, larger than Yellow Jersey; flesh yellow; quality very good to excellent.

**Yellow Jersey (Little-Stem Jersey).**—Vines small, slender, long, 6 to 12 feet; stems green, hairy, often flattened; leaves shouldered or entire, hairy only on upper surface, green; petioles green, hairy. Roots dark russet yellow, long or short, spindle-shaped to ovoid (two types known on the market, one long spindle-shaped and the other short and thick), surface smooth or veined, small to medium in size; flesh yellow; quality very good to excellent.

**Maryland Golden.**—Vines and leaves similar to Big-Stem Jersey. Roots short, thick, spindle-shaped; skin golden yellow; flesh deep orange; less firm than Big-Stem Jersey, otherwise similar to it.

**Orlis (Orange Little Stem, Jersey Orange).**—Similar to Yellow Jersey except that flesh color is deep orange and less firm.

## NONFOOD TYPES

In the late 1930's when it appeared that new varieties would soon be needed especially for the preparation of sweetpotato starch, breeding work with that objective was started by the United States Department of Agriculture and many State agricultural experiment stations. From that work the Louisiana Agricultural Experiment Station developed and introduced a heavy-yielding, white-fleshed, high-starch variety named "Pelican Processor." It is somewhat resistant to stem rot and is especially adapted to the lower South. The Department, in cooperation with several State experiment stations, developed a somewhat similar high-yielding, high-starch variety named "Whitestar," which is also good in the lower South but better adapted to the middle and more northerly sweetpotato districts than is the Pelican Processor.

Both of these varieties greatly outyield the table varieties under comparable conditions; but neither is recommended for food, because of their relatively low eating quality. The flesh of both is white and

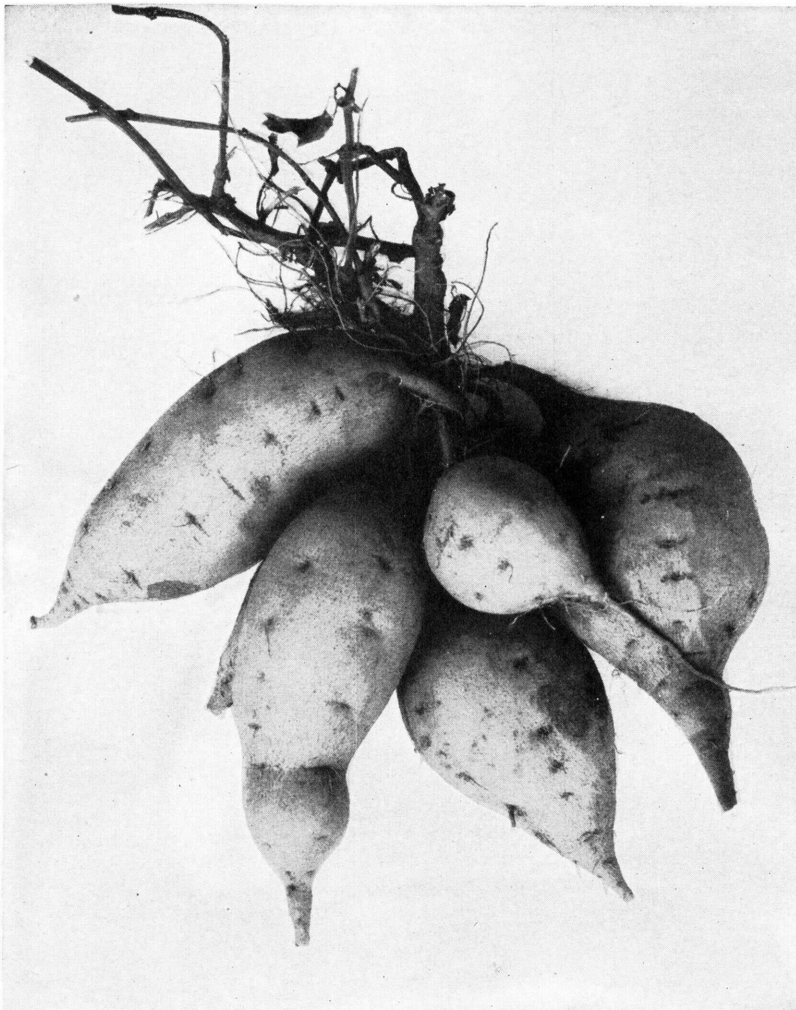

*Figure 3.*—A hill of Big-Stem Jersey sweetpotatoes.

therefore contains no significant amount of carotene. Where mere tonnage of carbohydrates per acre is desired these varieties are doubtless the best available for the respective areas indicated.

## CROPPING SYSTEMS AND SOIL MANAGEMENT

On most farms it is hardly practical to work out a definite, long-time, conventional crop-rotation plan that will include the acreage of sweetpotatoes desired each year. The great differences in labor requirement between sweetpotatoes and many other crops and the rather exacting soil requirements of some crops interfere with such plans. On truck farms the frequent need for changes in plans for one crop or another on account of market prospects or weather conditions also prevents adherence to a fixed long-time plan. It is, however, highly

important to avoid growing sweetpotatoes too often on any one area of soil.

Growing sweetpotatoes year after year on the same area helps various disease-causing organisms to build up rapidly, thereby seriously reducing yields and quality after a few years. Some of these organisms, such as the one that causes stem rot, persist in a field for a great many years, once they have become established. If proper precautions are taken (see p. 21) and sweetpotatoes are grown but once in 4 or 5 years on a given piece of land, there is no great likelihood that the land will become seriously infested. No special rotation needs to be followed, but several other crop plants should be grown during the 3 or 4 years between crops of sweetpotatoes.

Sweetpotatoes are grown over a wide range of territory on farms of many different kinds—truck farms, dairy farms, cotton farms, tobacco farms, corn-and-hog farms, and others. Obviously, the crops that should be grown on any one field during the years between sweetpotato plantings on that field will depend on what other crops are most profitably grown on that farm. In general, however, most of the other well-adapted general farm or truck crops are satisfactory.

The sweetpotato does best on soils of light to medium texture, and it requires but moderate amounts of soil nitrogen and organic matter in comparison with most other truck crops. At the same time it is essential that cover crops and green manures be grown in the cropping system. The soil must be protected from erosion, and productivity must be kept high for other crops that will be grown as well as for the sweetpotatoes. In the more northerly districts sweetpotato harvest is completed so late that rains following harvest may seriously delay the planting of a winter cover. Every effort should be made, however, to get a suitable cover crop planted. Long delay may require abandoning plans for the desired cover crop and sowing a substitute that will be better suited to the lateness of the planting. If it is too late to plant a winter legume, a winter-grain cover should be used.

The sweetpotato can follow successfully any one of a wide variety of crops or be grown on new land. The remains of preceding crops rarely cause difficulty, especially if those remains have been plowed or disked into the soil in the fall before sweetpotatoes are to be grown. Sweetpotatoes should be transplanted only after the soil has warmed up well, in the late spring. There is therefore time for the partial decomposition of winter cover crops between each spring plowing and the final fitting of the soil and transplanting the sweetpotatoes. Newly cleared land will require extra work for removal of roots and other trash that will interfere with the culture and harvesting of sweetpotatoes.

Experience has shown that it is undesirable to grow sweetpotatoes in soils containing large amounts of rather fresh or raw green manures or animal manures that are rapidly decomposing. Such materials may not only interfere with the operation of farm implements but tend to stimulate an unsightly dark spotting or blotching, called scurf, on the skin of the sweetpotatoes. Animal manures should usually be applied to other crops in the cropping plan rather than immediately before planting sweetpotatoes. It is also well to plow down green manures preceding sweetpotatoes before the amount of material becomes so great as to interfere with final fitting of the soil for transplanting.

## PRODUCING PLANTS OR CUTTINGS FOR TRANSPLANTING

### PLANTS VERSUS CUTTINGS

Sweetpotato plants for transplanting are produced by bedding mother roots (seed) in warm soil or sand and then removing the sprouts or plants that grow out from buds on those roots. These plants are also called draws, and sometimes they are called slips. Usually, however, the word "slip" is used for the cuttings made from the early vine growth of transplants; such cuttings are transplanted in the same way as plants, or draws. To avoid confusion, in this bulletin the words "plants" and "cuttings" are used to distinguish these two kinds of propagating material.

For the country as a whole most of the sweetpotato crop is transplanted with plants pulled from mother roots in plant beds. This method produces the earliest available material for transplanting. Plant beds, however, are relatively expensive to construct and operate. They require storage of large amounts of seed stock. Furthermore, they are recognized as a very common source of infection of transplants by various disease organisms. A few infected mother roots in a bed can transmit disease to many plants pulled from that bed, which in turn can badly infest a clean piece of land when transplanted.

To reduce the costs of seed stock necessary and of building and operating large plant beds and to avoid the disease hazard of plants from mother roots many growers in the South plant much of their acreage with cuttings. There is less danger of carrying disease organisms into the field on (or in) cuttings taken from healthy vines of early-transplanted plants than on plants pulled from the average plant bed containing average seed stock. This is a very important advantage of cuttings over plants. Use of cuttings is a sound method of getting clean plants from seed stock known to contain, or suspected of containing, roots contaminated with certain disease organisms. (See p. 24 and Farmers' Bulletin 1059, Sweetpotato Diseases.)

The growing of a seed-stock plot or a field from cuttings to help insure against the spread of sweetpotato diseases is highly recommended. Except in the southernmost districts, however, any other advantage of cuttings is very doubtful. In the middle South it is a common practice to produce only enough plants in a plant bed to transplant about a fifth to a third of the acreage to be grown. From this "mother patch" cuttings are obtained for transplanting the rest of the acreage. Waiting for vine growth to furnish cuttings makes planting so very late that yields are seriously reduced. (The costly effects of late planting are discussed further on p. 27.) Wherever the use of cuttings, or "slip seeding," delays planting enough to reduce the value of yields much more than the saving in cost of seed stock, cuttings should be used only for the production of a clean seed-stock plot. After all, the obtaining of the cuttings from the mother patch costs labor, and cuttings are harder to handle in planting machines than are plants. Furthermore, early removal of one-half to three-fourths of the vine growth for cuttings reduces the yield of the mother patch about 15 to 20 percent. The later and heavier the cuttings are made, the more serious the reduction.

### CLEAN SEED STOCK A NECESSITY

For bedding purposes by any method, the grower should use only seed stock that is known to be free of any signs of disease and that has

been carefully selected *in the field at harvest* for seed purposes. (See p. 35.) If the grower has saved no such seed stock, he should try to get it from another grower who is known to produce seed stock of dependable quality and of reasonable freedom from disease. Lacking such a source, he should inquire through his county agricultural agent or State extension service about sources of certified seed or plants for establishing a clean stock of his own.

### PLANT BEDS IN THE OPEN

In the warmest parts of the lower South, where little freezing occurs, seed sweetpotatoes are bedded in open soil with no artificial heat or protection. Only well-drained, light soils that warm up early are suitable, and an area that has had no sweetpotatoes grown or bedded on it for several years should be chosen. About February first the soil is plowed deeply and ridges are thrown up about 1 foot high and 3 feet apart. A 4–12–4 or 5–10–5 fertilizer is worked into the soil along the rows before the ridges are formed. The ridges are allowed to settle and the soil is allowed to warm up for 2 to 3 weeks. Then the ridges and middles are cultivated to kill weeds, shallow furrows are opened atop the ridges, and the seed roots are planted a few inches apart, lengthwise of the ridges, and covered 2 inches deep. Plants become available for transplanting in 6 to 8 weeks.

Outdoor beds may also be prepared as follows. A strip of soil 5 to 6 feet wide and as long as necessary is worked up thoroughly, and the surface is raked or dragged smooth and level. The seed sweetpotatoes are placed by hand, about ½ inch apart, on the soil and then uniformly covered with sand or light soil about an inch deep. When the sprouts break through this covering, another inch of sand or soil is added.

Open beds should be placed if possible where they can be watered easily. The beds should be watered after each pulling of plants to resettle the covering of soil about the roots and remaining small sprouts.

When roots are bedded as described, about 15 square feet (3 feet of length of a bed 5 to 6 feet wide) is required per bushel of roots planted.

If desired, the plants can be left in place on the ridges to produce vines from which cuttings can be made for later planting. It should be remembered, however, that late planting reduces yields. This open-bed method produces later plants than can be obtained from hotbeds and therefore is recommended only for the warmest parts of the South.

### HOTBEDS

Except in the warmest parts of the Gulf States, sweetpotato plants are usually produced in hotbeds of one kind or another. Coldframes can be used in certain narrow districts adjacent to and slightly cooler than those in which beds are made in the open. In practice, however, coldframes are not common. Wherever it is necessary to provide any artificial structure for protection of the plant bed and to raise its temperature, artificial heat is usually supplied by fermenting manure or other suitable organic matter, by heated flues, pipes, or by specially designed electric heating elements.

In this bulletin only the general features of different kinds of hotbeds and methods of heating are described. For details of construction, see Farmers' Bulletin 1743, Hotbeds and Coldframes.

### Hotbed Frames and Covers

Hotbed frames are covered with cloth in the warmer districts and with glass sash in the cooler districts. Glass sash gives much better protection from cold and allows much more sunlight to reach the bed than does a cloth cover. Glass sash also sheds hard rain, much of which may go through cloth and thus chill the beds and make them too wet. The initial cost of glass sash is much higher than that of a cloth cover, but sash can be used for many years if handled with care. A cloth cover can rarely be used more than two or three seasons.

In locations too far north for cloth to be suitable, glass gives better results than the commonly available "glass substitutes" because it transmits light better than the other materials. The sturdiness of glass sash makes it much easier to put on and take off straw or mats needed for additional protection than if the covers are cloth. Furthermore, in regions where much heating is required, much of the higher cost of glass sash will be offset through savings in heating costs.

The frames of hotbeds vary in width from 4 to 12 feet, but a width of about 6 or 12 feet is best. If standard 3- × 6-foot hotbed sash covers are used, frames of single-width beds should be 5 feet 8 inches wide. This is a convenient width regardless of the kind of cover. The bed length may be a multiple of 3 feet, to fit the standard sash. Temporary frames are made of lumber and permanent structures are made of brick, hollow tile, concrete, cinder block, or concrete block. Permanent structures have a relatively high first cost, but the building of temporary frames every year is also costly in labor and depreciation of material.

The frames for beds the width of a single sash are built with one side (usually called the back) some 8 to 10 inches higher than the other to give an effective slope to the sash. The low side should extend at least 8 inches above the final soil surface in the bed. The entire frame-and-cover assembly should be well-fitted and tight to keep the heat in.

The sides of the frames for double-width beds for glass sash are of the same height and 11 feet 4 inches apart. Down the middle a ridge is mounted on a row of posts 8 to 10 inches higher than the sides. For cloth covers the ridge may be only a pole or other narrow member, but for sash covers it should be wide and strong enough to carry the upper ends of the two rows of sash—of 2 × 4 or 2 × 6 dimension laid flat.

All wood in permanent structures should be cypress, redwood, or other rot-resistant species.

### Manure-Heated Hotbeds

On farms where plenty of fresh horse or mule manure is available, this is usually the cheapest material for heating a hotbed. On the other hand, the labor of handling and preparing it for the bed and the difficulty of accurate control of the heat from manure are disadvantages. Manure that is contaminated with remains of diseased sweetpotatoes should not be used.

Only manure that has not gone through a period of heating should be used. To prepare it for the hotbed it should be thoroughly mixed, moistened throughout if it does not appear uniformly moist, piled, and then turned and mixed two or three times more. This should be done just before the bed is prepared so that the manure will start to heat soon after it is put in the bed.

In the milder areas the manure can be packed down on the soil surface in a flat pile about 3 feet wider and longer than the covered temporary frame (fig. 4). Two inches of soil is put over it, and the frame is put on top. Two inches of sand is then put in the frame, and the bed is covered. It is generally better, however, to dig a pit a foot wider and longer than the temporary frame and of suitable depth and to pack the manure into this pit approximately to ground level. Soil is then put over the manure, and the frame is put in place and banked with soil around the outside.

In the warmer districts manure well packed to a depth of only 6 to 8 inches will give enough heat. In the cooler districts a depth of 8 to 12 inches is usually necessary. After the cover is put in place, several days must elapse for the fermentation of the manure to reach

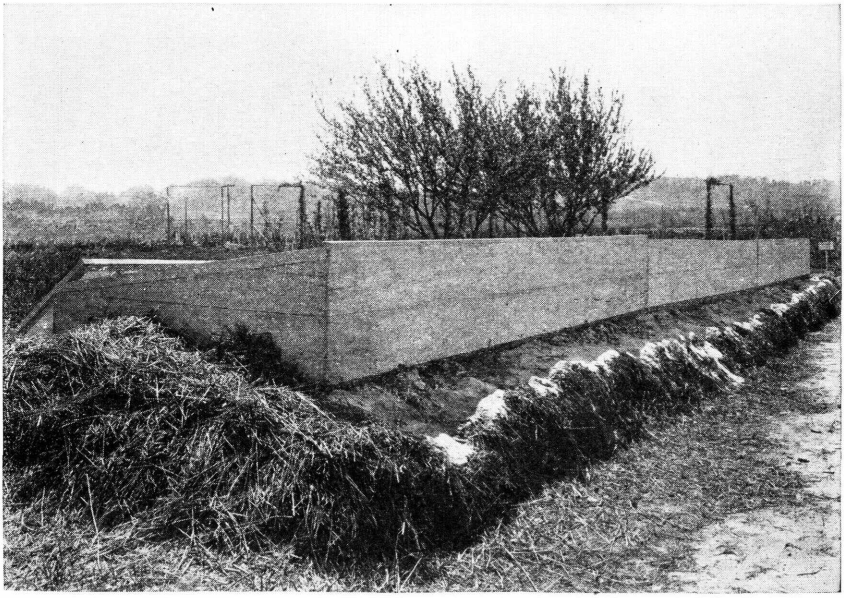

*Figure 4.*—**Manure-heated hotbed built entirely above the ground level.**

and pass its peak. When the temperature of the soil has gone down to 80° F., the sweetpotatoes may be bedded. It is necessary to have a good soil thermometer and to note the temperature at least once daily to know the condition of the bed.

Manure-heated beds may be as long as desired, since the source of heat is distributed throughout the length of the bed.

#### Flue-Heated Beds

Where electric power is unavailable or too expensive for heating hotbeds and manure is unavailable or considered undesirable, sweet-potato beds are often heated by flues leading from a firebox under one end of the bed to chimneys at the opposite end. Wood is the usual fuel.

Flue heating is satisfactory for beds up to 50 feet long. If the flues are longer than that, the end of the bed opposite the firebox can-

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*Figure 5.*—**Flue-heated hotbeds.**

not be kept warm enough without getting the end near the firebox too warm.

One type of installation is built as follows: 8-inch clay-tile flues are buried in the soil $2\frac{1}{2}$ feet apart on centers. At the firebox end of the bed the flues are about 18 inches below the level of the soil on which the sweetpotatoes are placed at bedding. The flues slope upward slightly, reaching only about 8 inches below the level of the bedded roots at the opposite end. Fireboxes are constructed in many ways. Some are well-built brick or stone structures with iron doors. Others are no more elaborate than an old oil drum laid on its side with one end cut out and the other end connected to the flue. Chimneys are of sheet metal, tile, or even wood. Wood construction exposed to the flue gases is, of course, a fire hazard.

A more common flue-heating arrangement consists of a heavy wooden hotbed with a floor, or a bottom, of cheap lumber built over a long, narrow, shallow pit. The bed is usually supported on heavy, cheap, rough-hewn wooden members. There is a firebox about 6 feet from one end of the bed that discharges hot gases into an earthen passage leading to the pit under the bed. The firebox is set back a few feet to reduce the danger of setting fire to the wooden bed structure or of overheating the bed. There is a chimney at the opposite end. The fire hazard is greater in this kind of bed than in the kind heated by buried tiles. The moist soil and watering of the bed, however, keep the wooden structure moist enough so that it will not catch fire if the fire in the box is kept under proper control (fig. 5).

A wooden bed constructed over a pit was formerly considered economical and relatively efficient. Under many conditions today, how-

ever, it is too expensive because of the high costs of labor and materials for construction and of labor and fuel for heating and the high rate of depreciation. The fires for such beds require frequent attention, and heat waste is high. Flue heat is being rapidly displaced by electric power.

### Electric-Heated Beds

As electric power at reasonable rates becomes available to more and more farmers, the old-fashioned manure- and flue-heated beds tend to become obsolete. Beds to be heated by electricity should be very well built and thoroughly insulated in order to hold the power cost down to a reasonable figure. Even at relatively low rates for electricity, a poorly built hotbed will be too costly, because of the power that will be wasted. In some communities the electric rates are too high for economical use of electricity in heating hotbeds. Representatives of all power companies that serve rural areas are familiar with the power requirements of electric hotbeds in their own localities and can estimate the probable costs at their respective rates. Rural-electrification specialists at the several State agricultural experiment stations and county agricultural agents can also advise growers of probable costs in their respective localities.

Large electric-heated hotbeds are shown in figure 6.

The cost of suitable bed construction and of electric power may tend to discourage many prospective users of electric hotbeds. With these costs, however, must be compared the great savings in labor and the better results that can be obtained with automatically controlled elec-

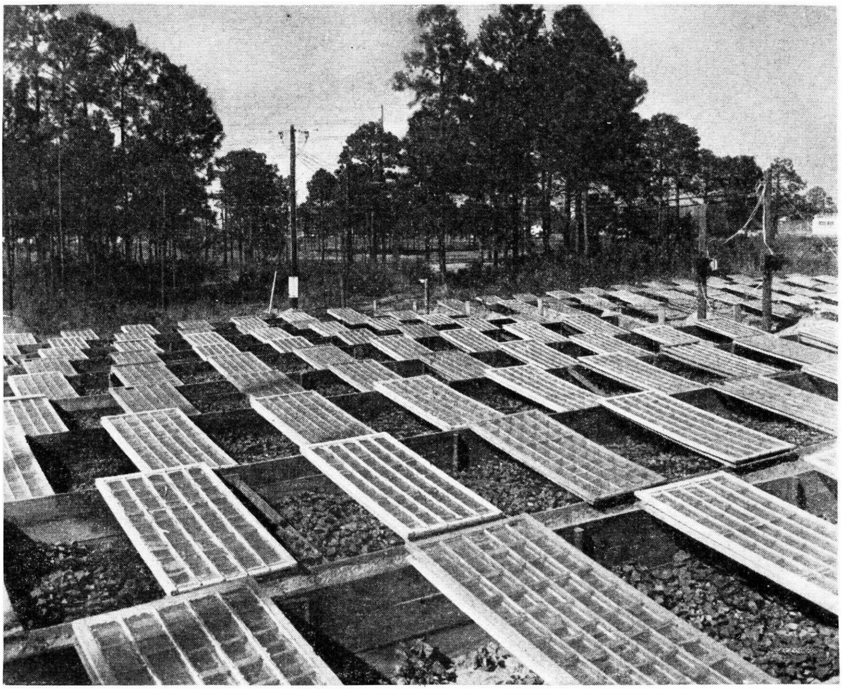

*Figure 6.*—Large electric-heated hotbeds.

tric heat. When these factors are considered, electric beds are often found to be the cheapest in the long run.

Where electric heat is used permanent structures have many advantages over temporary ones. In the cooler districts where much heating is necessary, fairly elaborate provisions against heat loss are justified. Suitable conditions can be usually supplied at a lower cost for a period of years by a well-planned, well-built structure that does not have to be rebuilt every year.

In cool areas the bottom of the bed should be excavated about a foot below the soil level. About 4 inches of coarse gravel or *coarse* cinders is put in the bottom to keep the heated part of the bed well away from the cold, wet soil below. This is covered with a layer of clean straw or other coarse litter that will settle down to a thickness of about 2 inches when soil and sand are put on top of it. The coarse litter gives further insulation from the cold bottom of the bed and thus keeps much heat from being lost downward. The litter is covered with a thin layer of soil of medium texture, just enough to keep the bedding sand or light soil from sifting down through the litter. Finally, an inch of sand is carefully leveled over the entire bed. The heating cable is placed on the surface of the sand and electrical connections are completed. (See p. 19.) Four inches of sand or sandy soil is put over the cable, the thermostat bulbs (see p. 20) and thermometers are put in place, the sash is put on the bed, and the bed is then ready for heating to be started. Placing the roots in the bed is described on page 21.

Some variations in the directions just given may be made, depending upon local weather conditions and materials available for preparing the hotbed. Good drainage, tight construction, tight covers, and thorough insulation must, however, always be provided.

### *Electrical Equipment*

This bulletin on growing and harvesting of sweetpotatoes is not intended as a handbook on electrical wiring or electrical heating equipment. Such details can be obtained better at first hand through the assistance of representatives of local power companies or cooperatives. The principal features of more or less standard electric hotbed equipment and its use are, however, described briefly.

Standard, lead-sheathed, hotbed-heating cable is recommended. It is made so that single elements or "loops" must be 60 feet long for operation on 110 to 115 volts or 120 feet long for use at 220 to 230 volts. The 60-foot element consumes approximately 400 watts of power and the 120-foot element 800 watts. Under most conditions in a well-built bed a 60-foot element is recommended for each two standard sash, or 6 by 6 feet of bed. Similarly, a 120-foot element will heat the equivalent of four sash, or 6 by 12 feet of bed. Figure 7 shows a practical method of arranging the cable in the bed to give uniform distribution of heat. The strands of the cable should be no more than 7 to 8 inches apart in the bed.

Automatic control is furnished by effective thermostats that are available at reasonable cost. One standard hotbed thermostat, rated at 25 amperes, will handle a maximum of 6 of the heating elements described (for 12 sash at 115 volts or 24 sash at 230 volts). In locating thermostats and laying the heating elements in large beds, it is gen-

erally better to arrange them by groups of sash than to have part of the area under any group of sash controlled by one thermostat and part by another.

Permanent locations for electric-heated beds are desirable, in order to avoid the considerable costs of relocating power lines that serve the beds, from year to year. For beds of permanent construction good weatherproof electrical installation and fittings will save much time and trouble over a period of years. Crude, temporary installations may be satisfactory for any one year, but they require more labor for repeated installations and also are shorter lived than permanent ones.

Since the bedding sand or soil must be renewed each year, it is well to remove the old mother roots and sand soon after transplanting is

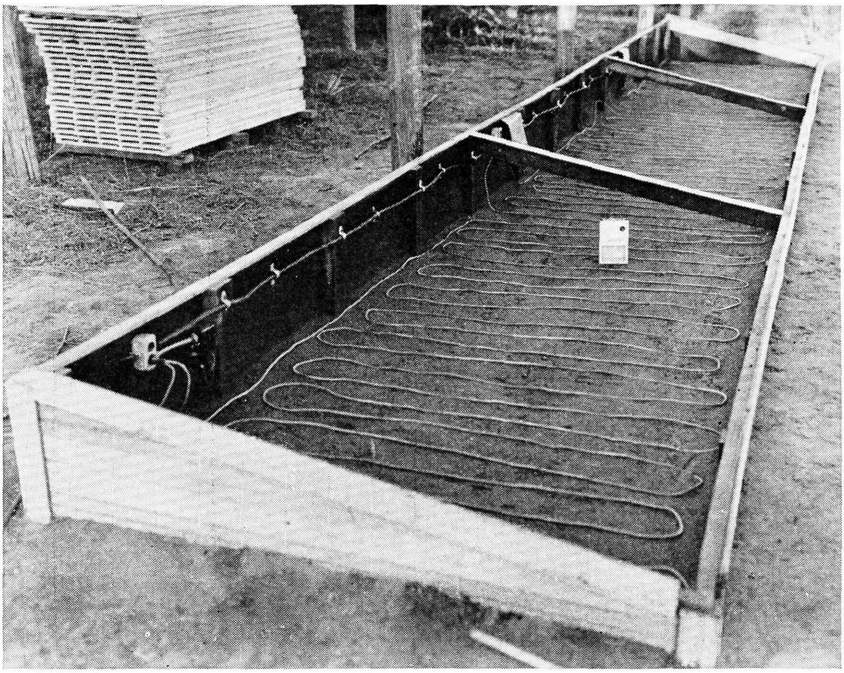

*Figure* 7.—One recommended manner of arranging hotbed-heating elements in a bed 6 feet wide.

completed. At this time the heating cables should be carefully taken from the beds, straightened out, and rolled into large, neat coils for safe storage. The thermostats should also be carefully put away.

Some operators lay four-mesh hardware cloth in the sand about an inch above the cable in the bed to guard against damage to the cable by any tools that might be used in working in the bed. The lead covering of the cable is easily cut or broken by striking it with a shovel in removing the old sand. If no hardware-cloth protection is installed, no tools should be used in the bed until the old roots and plants have been pulled out by hand and the cable carefully removed by hand. Care must be taken to avoid kinks in the cable or sharp blows that might break the lead sheath. If the roots and soil are not very compact in the bed, the cable may be pulled out before the roots.

The elongated thermostat bulb should be buried horizontally in the bed at the level of the lower portion of the mother roots. It should be placed about the middle of the area controlled by the thermostat, and a good soil thermometer should be placed next to it with the thermometer bulb at the same depth. The control knob on the thermostat should be adjusted so that current will be turned on and off as near 80° F. as possible. The thermometer should be read from time to time to insure that the thermostat has been set and the bulb placed so that it can maintain the desired temperature at the level chosen in the bed. Full operating instructions are furnished with each instrument.

#### Hot-Water-Heated Beds

Heating hotbeds by hot water in iron- or steel-pipe coils is less common than formerly. Although the method is effective, it has been largely displaced by electrical heating. Original costs of such pipe installations are relatively high for such short seasonal use. If an ample source of hot-water heat is available in connection with other operations such as a greenhouse or a poultry brooder house, costs for the hotbed may be substantially lower. For use only in producing sweetpotato plants, hot-water heat is of doubtful economy under most conditions. If, however, other available methods have serious draw-backs, hot-water heat may be worth consideration. It is also feasible where a cheap gas supply is available. Hot-water-heated beds are described briefly in Farmers' Bulletin 1743, Hotbeds and Coldframes, and more fully in Leaflet 124, Sash Greenhouses.

### AMOUNT OF SEED STOCK REQUIRED

The recommended distances for spacing sweetpotato plants in the field require 10,000 to 12,000 plants per acre. To obtain this number of plants all at one early pulling requires the bedding of at least 10 to 12 bushels of roots of good quality. A thousand plants per bushel of seed roots at the first pulling is a good yield. Since a bushel of good, medium-sized roots properly handled should produce a total of 1,500 to 2,000 plants in 3 pullings at weekly intervals, it may appear extravagant to bed as much as 10 to 12 bushels of seed per acre to be planted. A 2-week delay in planting, however, while the farmer is waiting for more sprouts to grow may reduce the total yields 30 to 50 bushels per acre and the yields of No. 1 grade by 20 to 30 bushels per acre.

Since several days are usually taken in completing any extensive planting on any one farm the latter part of the job can be done with a second pulling of plants. Where the crop is grown intensively and the growing season is relatively short the need for plenty of plants at the first pulling is most pressing. It is only in the warmest part of the lower South that the earliest practicable plantings are not the most profitable. Planting should not be stretched out over 2 or 3 weeks, while the grower waits for plants, but completed in a few days after the earliest safe dates for planting. This requires the bedding of at least 10 bushels of seed for each acre. Even this amount will not be enough if the roots have been harvested too late, stored at too low temperatures, or handled roughly.

## SEED TREATMENT BEFORE BEDDING

Only special field-selected (see p. 35) sweetpotatoes as free from disease as possible should be used for seed. All roots that show any rots or disease injuries of any kind should be kept out of the bed. Even with these precautions there is the possibility that clean-looking roots may carry certain disease organisms on their surfaces. Such surface organisms can be killed by disinfection, but the treatment will not eliminate disease organisms under the skin or deep inside the root. Disinfection is a rather rigorous treatment that tends to depress sprout growth in the plant bed.

Just before the roots are bedded, they may be disinfected by treating them for 8 to 10 minutes in a solution made by dissolving 3 ounces of corrosive sublimate (mercuric chloride) in about 2 gallons of hot water and making the solution up to 24 gallons with cold water. Only wooden or stone vessels should be used for disinfection. The addition of 5½ pounds of wettable sulfur to 24 gallons of this solution increases its effectiveness. After about 10 bushels have been treated in 24 gallons of solution, ½ ounce of corrosive sublimate dissolved in hot water should be added and the solution made up to the original volume by the addition of water. Repeat the process after the treatment of another 10 bushels; after treating a third lot of 10 bushels, throw away the solution and start with a fresh one.

**Corrosive sublimate is very poisonous. Sweetpotatoes treated with corrosive sublimate should never be fed to animals or used as food. The chemicals and the solutions remaining after treatment with them should be carefully disposed of and kept out of reach of children and animals.**

## BEDDING THE ROOTS

For the plant bed only soil that has had no sweetpotatoes in it for many years should be used. If it is available, use soil that has never had sweetpotatoes in it and that has received no drainage water from a field or bed of sweetpotatoes. Sand should be fresh and clean.

In growing the varieties having deeply colored flesh, it is important that off-type, light-colored roots be kept out of the plant bed. If only a few bushels of seed are to be bedded or if the bed is intended for a special plot for seed stock, the interior color of every root should be examined. This can be done rapidly by cutting a small nick near the stem end of each root, where it is about ½ inch in diameter, and noting the flesh color. If the flesh is undesirably light, deficient in carotene, the root should not be put in the plant bed.

The hotbed should be warmed up or cooled down to 80° F. before the roots are bedded. Treating the roots and putting them in the hotbed should be done on a comparatively warm, fair day to avoid letting the hotbed become too cold while the work is being done. The roots should be bedded immediately after treating. Roots of similar size should be bedded together so that they can be covered to equal depth. Mixed sizes result in unequal covering. The roots are pushed firmly down onto the surface sand or soil of the bed about a half inch apart in all directions (fig. 8) and then they are covered to a depth of 1 inch with clean sand or sandy soil. The sand is sprinkled with water to settle it about the roots. The covers are put over the bed as

*Figure 8.*—**Bedded roots ready to be covered with sand.**

promptly as possible to avoid any chilling of the roots. An inch or two of fine litter over the bed surface will help conserve moisture. It should be removed when sprouts appear.

### PLANT-BED MANAGEMENT

The bed temperature should be about 80° F. at the time of bedding and the bedded roots kept between 75° and 80°. This temperature range should give a good supply of plants in about 6 weeks. On bright, warm days the temperature will rise rather high under glass sash, making it necessary to lift some of the sash to keep the temperature down. It should not go above 85°.

Beds heated by flues, pipes, or electricity tend to dry out a little faster than those heated by manure. The beds will need watering with a sprinkler from time to time, the frequency depending on the amount of ventilation given to help control the temperature. The bedding material around the roots should be examined through its depth every few days to insure that it does not become too dry for plant growth. Care must be taken also to avoid putting on so much water that it runs through the bed into the manure or insulation below the heating cables. Excess watering tends to chill the beds, waste heat, and check plant development. Whenever possible, watering should be done during warm, bright periods to avoid chilling the beds or plants. As large numbers of plants develop, the need for water increases rather rapidly. Before the sprouts appear very little is needed.

As large numbers of good plants develop, the covers should be left open as much of the time as the weather is warm. For about 10 days before transplanting starts and thereafter the covers should be left off all the time unless there is danger of an untimely frost or near frost.

Sprouts, or plants, of all except the so-called "bunch," or "bush," varieties for transplanting should be about 8 inches long before they are pulled from the mother roots (fig. 9). Assuming that the soil or sand covers the roots 2 inches deep, the plants should stand about 6 inches tall above the soil. There is little difference in value among plants ranging from about 6 to 10 inches in length, provided they are sturdy and free of disease. Plants shorter than 6 inches are a little awkward to handle in transplanting, and plants much smaller than 6 inches do not give as good stands or yield as well as those about 6 to 10 inches long. Plants longer than 10 inches also are troublesome to transplant. If more than 4 to 5 inches of the transplant is left out of the soil, it may be subjected to excessive wilting. Excessively long plants may be set at an angle in order to avoid setting them at a troublesome depth into the soil.

For machine planting, it may be necessary to trim back the base ends of excessively long plants or cuttings to a length that is convenient to handle. The only reason for trimming plants is to make them convenient to handle and to avoid excessive stem length above the soil. The leaves should not be removed from the part (or the whole plant) that is transplanted. Most of the small roots that are on the plants when they are pulled from the bed die and are of no proved advantage. The prompt formation of new roots after transplanting is important to successful establishment of the new plant.

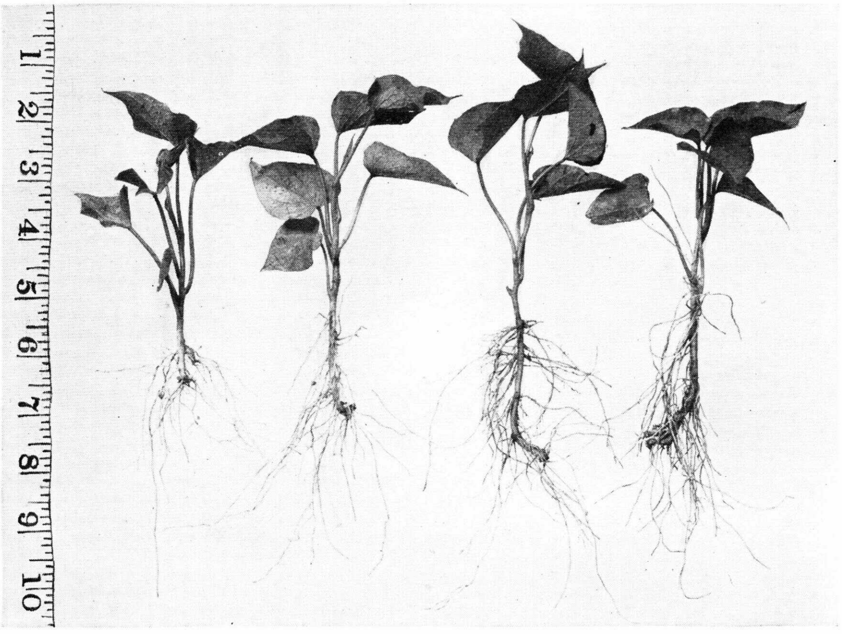

*Figure 9.*—Sweetpotato plants, or draws, for transplanting. All four of these plants are of good growing quality, but the one at the left is too short for easy handling. The second and fourth plants are satisfactory, but the third plant is the best size.

The bunch varieties produce short stems with the leaves close together. The plants are pulled from the beds when only 4 to 6 inches long. For machine planting such short plants are a distinct disadvantage.

### TREATMENT OF PLANTS OR CUTTINGS

Plants and cuttings are usually transplanted with no treatment of any kind; they must be kept cool and moist until planted. In some experiments on soils infested with disease-producing organisms, dipping the plants, soon after pulling, in a fungicide such as bordeaux mixture has tended to reduce the amount of disease found at harvest-time. It is considered much more effective, however, in controlling disease, to keep plant beds free of infestation and to plant on clean soils. If either plant beds or field soils are badly infested, treating plants with a fungicide dip is of little or no value.

Sweetpotato plants or cuttings form new roots so readily after transplanting that it is unnecessary to treat them with any chemical to stimulate root formation.

### CUTTINGS FOR TRANSPLANTING

The best cuttings consist of about 8 inches of the ends of sturdy vines. Cuttings from the middle or near the ends of vines 2 to 3 feet long are also satisfactory. Those from near the base of the vines that are long, however, consist of older harder tissues that start growth less readily after transplanting and that are definitely less productive. Cuttings should, of course, be taken only from strong, healthy plants. They may be taken either from open-field plant beds or from early transplants that have produced vines.

As emphasized on page 12, the use of vine cuttings makes transplanting too late for the most profitable yields, except in the warmest parts of the lower South. In general, cuttings should be used for growing disease-free seed stock rather than for the main crop of sweetpotatoes. (See Farmers' Bulletin 1059, Sweetpotato Diseases, for descriptions of diseases and methods of control.) Near the Gulf of Mexico, where very early planting results in too many rough, oversized sweetpotatoes that are undesirable for storage, cuttings are available in time for planting the main crop.

## PURCHASING PLANTS

Sweetpotato plants can be purchased from growers who specialize in the production of plants for transplanting by others. Some States maintain certification services to help insure that such plants shall be relatively free from disease when sold. State and county agricultural agencies can suggest sources of certified plants and of certified seed stock.

For the small grower who needs only a few thousand plants, purchase from a dependable source may be cheaper than producing his own.

## COMMERCIAL FERTILIZERS

High yields of sweetpotatoes of high quality can be obtained only on soils of high fertility, good drainage, and suitable texture. Since the sweetpotato forms roots of most desirable shape and is easiest to harvest on the lighter soils, it should be grown on those soils although

the natural fertility is only medium to low. The sweetpotato responds very profitably to good soil management and fertilizer practices.

There are small differences in superiority of various recommended fertilizer mixtures from place to place, but the recommendations are remarkably similar among most of the States where the crop is grown. The most profitable yields have been generally obtained with 1,000 to 1,500 pounds per acre of mixtures containing 2 to 4 percent of nitrogen, about 8 percent phosphoric acid, and 8 to 10 percent potash. On fields where good amounts of green manures or animal manures have been turned under, often no more than 2 percent of nitrogen is needed. On the lighter, sandier soils, 10 percent of potash is recommended.

The application of as much as 1,000 to 1,500 pounds of fertilizer generally should be made in two stages. Just before the ridges are prepared, about 2 weeks before planting, 600 to 800 pounds per acre of the fertilizer may be thoroughly mixed in the soil where the ridge is to be; then the ridge is thrown up so that most of the fertilizer lies deep in the ridge. The remainder of the total amount is applied as a top dressing to the sides of ridges 2 to 3 weeks after transplanting. The top dressing becomes mixed with the soil during cultivation for weed control.

Recommendations of the Mississippi Agricultural Experiment Station, based on experiments in that State, call for more nitrogen in the fertilizer than is recommended in other States—6 to 7 percent nitrogen. That station also recommends applying all fertilizer beneath the ridge before planting. On the lighter soils in other States, however, applications of more than 1,000 pounds per acre under the ridge has often caused some injury to young plants.

## LIME

The sweetpotato does best on soils that are slightly to moderately acid. On very acid soils that are deficient in calcium, applications of ground limestone have given marked increases in yield. Lime-requirement determinations [1] should be made to find the amount of lime to apply. It is definitely undesirable to apply so much lime that the soil is made neutral or nearly so. If there is too little acidity, diseases such as soil rot, or pox, and scurf are likely to become troublesome. On reasonably productive soils it is usually unnecessary to apply lime for this crop.

## FITTING THE SOIL FOR TRANSPLANTING

Heavy cover crops or heavy, coarse remains from a previous crop on the land—such as cornstalks or cotton stalks—should be chopped up and partly worked into the surface soil before plowing. Cover crops should be plowed under before they become so bulky as to interfere with operations after plowing.

Land for sweetpotatoes is plowed about 7 inches deep and thoroughly disked or harrowed promptly after plowing as for any other truck or garden crop, about 3 to 4 weeks before transplanting time.

The first application of fertilizer is made and the ridges are thrown up about 2 weeks before transplanting. Methods of putting down

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[1] See your county agricultural agent or write your State agricultural experiment station or extension service for instructions on how to take soil samples and where to send them for determination of lime requirement.

this fertilizer and making the ridges differ considerably, depending on the implements available for the work. With small, one-horse tools the row is marked off with a shallow furrow made with a one-horse plow and then fertilizer is applied in this furrow by hand. The fertilizer is next mixed somewhat with the soil by dragging the plow through the furrow or by running a single shovel or similarly effective horse-drawn implement through it. The ridge is thrown up over this furrow by backfurrowing twice with a turning plow.

A two-horse, one-row cultivator equipped with disk hillers is much more efficient than the small walking plow. After the fertilizer is put down a medium ridge can be thrown up with one trip along the row with this implement. There is now in common use one-man tractor equipment which places the fertilizer uniformly where desired, mixes it with the soil, and builds a precise ridge all in one operation. Regardless of the equipment and the details of procedure, essentially the same end results are obtained. Upon completion the ridges are left undisturbed until just before transplanting. Any weeds on the ridges should be destroyed by cultivation before transplanting.

On most soils suited to sweetpotato culture the ridges should be about 10 inches high from crest to furrow bottom after they have settled and are ready for the plants to be set. On sandy soils it is difficult to keep a ridge that high without making an excessively large ridge at the start. On such soils, however, the ridge hardly needs to be 10 inches high, assuming the soil to be well drained. On the heavier sweetpotato soils, especially if there is any tendency for the water from heavy rains to drain away slowly, ridges should be 12 to 14 inches high. It is possible to make ridges of adequate height and 3 to 3½ feet apart on centers on the less sandy soils without bringing up soil from too great depth. The higher ridges have to be farther apart than the lower ridges.

Ridge height is important not only in relation to surface water but to efficient culture and harvesting of the crop. If ridges are much less than 10 inches high at planting, the crop may lie so deeply in the soil that an excessive number of roots will be cut, broken, and even lost during harvesting.

In a few localities having very light soils sweetpotatoes are planted in 3½-foot check rows on flat land. After the vines become so long as to interfere with cross-cultivation, the rows are cultivated one way only and the soil is drawn to the rows, forming a low ridge. This method is not generally desirable.

## TRANSPLANTING

### TIME OF TRANSPLANTING

Early transplanting of sweetpotatoes is necessary if the best yields are to be obtained. Although high soil fertility and freedom from disease must be maintained, they usually cannot result in high yields unless the transplanting is done as early as the weather is warm enough. It is only in the warmest part of the lower South that good yields can be obtained from delayed plantings.

Sweetpotatoes should be planted, with rare exceptions, about a month after the *average* date of the last frost in spring, or about 10 days after the "frost-free" date. As soon as the leaves of most oak trees have reached their full size, it is time to plant sweetpotatoes.

Extensive experiments by this Department and various State experiment stations show that a 2-week delay in planting after that time reduced total yields nearly 40 bushels per acre on the average and yields of No. 1 grade 30 bushels per acre. A 4-week delay reduced total yields 86 bushels per acre and No. 1 yields 43 bushels. Further delays were still more serious. The crops in the dozen experiments over the South from which these figures were taken were grown by the methods recommended in this bulletin except that in each experiment there were five different dates of planting. The earliest plantings averaged more than 300 bushels per acre.

Transplanting the plants closer together in the rows will not make up for the yields lost as a result of late planting. The importance of transplanting as soon as the weather is warm enough can hardly be overemphasized. Planting "on time" will greatly improve average yields with only a moderate increase in cost of producing the crop, mainly in some higher cost for plenty of early plants.

It is best to transplant as soon after a rain as the soil is in good condition.

## METHODS OF TRANSPLANTING

Sweetpotatoes are transplanted by either hand or machine.

Immediately before transplanting, a pole or drag is drawn along the tops of the ridges to make a narrow, flat top on the ridge and to push aside the dry soil on top.

Transplanting machines not only save man labor but do a more uniform and generally more satisfactory job of transplanting than is done by hand. They are equipped with watering devices that put a small amount of water around each plant just before the soil is drawn around it. Three men with a 1-row planter, properly handled, will set 3,500 to 4,000 plants per hour—1 man driving and 2 men handling plants. With a 2-row planter, 5 men can set 7,000 to 8,000 plants per hour. If the soil is moist enough for setting the plants without water, considerably larger numbers can be set per hour, because stops for filling the water tanks are unnecessary. In general, water should be used when transplanting by machine, because the soil is usually dry enough at planting time for the plants to get some benefit from the water applied.

For efficient results with transplanting machines the work crews must have some experience and skill, the field must be well prepared, the water tanks must be refilled quickly, and the plants must be of medium size and neatly arranged for rapid handling. Waiting for plants or water is costly. Water should be brought to the field in large tanks or barrels. Plants of variable size, that are too large or too small, or that are tangled or disorderly in the bundles can easily waste 25 percent or more of the time of the crew of the machine. With well-organized, skillful operations, 10,000 plants can be set by machine with as little as 5 man-hours per acre, but unfavorable conditions may require 16 or more hours; 9 to 11 hours is about average.

By machine 25 plants per man per minute is a reasonably good rate of planting, while by hand methods 6 plants per man per minute is good. These rates apply to the entire transplanting crew, including those who drop the plants for hand setting or the man who drives the machine. If plants set by hand must be "watered in," the labor requirement increases from about 30 man-hours per acre to about 50

man-hours. Thus, plants set by hand with water take about 7 times the number of man-hours of work as those set by machine.

The low cost of application of water by machine makes the grower less dependent on the weather in determining when he can plant. In view of the losses in yield that follow late planting (or delayed starting of growth after planting), this advantage of the machine is often an important one.

Small growers who cannot buy a machine transplanter or cannot make it profitable in their small operations should consider the joint purchase and operation of a machine with a few of their neighbors.

Transplanting by hand is hard, slow work, no matter how it is done (fig. 10). One man may drop the plants at the desired intervals on the ridge for another who transplants them with a trowel or dibble. If the soil is loose and moist enough, the plants can be "stuck in"

*Figure 10.*—**Transplanting of large fields by hand is slow and wasteful of manpower, by modern standards.**

with a stick 3 feet long, having a broad v-notch in the end. When this method is used, two men are required to place the plants exactly on top of the ridge at the proper intervals and keep ahead of the man with the stick. The man with the stick places the notch over the stem of the plant near its base and pushes the basal part of the plant into the soil. The plant is pushed in 4 to 6 inches, depending on the character of the soil and the size of the plant. The soil is firmed about the plant with the stick or the operator's foot. This stick method is more popular than the use of a trowel or a dibble, because it is unnecessary for the operator to bend over in using it.

Transplants that are delayed in starting active growth fail to catch up with neighboring plants that do start growth promptly. Imperfections in the plants or the transplanting operation and cloddy or trashy spots in the ridges where plants are set may retard plants enough to make them unproductive laggards through the entire season. Planting skips or replacing dead or defective transplants 2 or 3 weeks after the field has been transplanted is unprofitable. Late replace-

ments become so crowded by their early starting neighbors that they rarely yield enough to pay for the trouble of transplanting them. *It is most important to get a full stand of good plants all at a single transplanting.*

### PLANTING DISTANCES

The ridges for sweetpotatoes are usually built 3 to 3½ feet apart on centers. If ridges of more than average height (10 to 12 inches) are required for adequate surface drainage, it may be necessary for them to be a little farther apart, up to 4 feet. Planting on soil too poor to make a crop in rows 3 to 3½ feet apart is a poor reason for making rows farther apart. It is better under such conditions to use enough fertilizer and to improve the soil to support a crop at efficient rates of planting. The fertilizer recommendations given on page 25 are based on the assumption that 10,000 to 12,000 plants will be grown per acre.

Spaces between plants in the row should be about 15 inches in rows 3½ feet apart. In some recent extensive experiments decreasing the interval from 16 inches to 12 inches in rows 3½ feet apart increased the total yields and yields of No. 1 grade less than 10 percent and decreased the Jumbo yields slightly. In consideration of the additional costs of plants, transplanting, and other factors involved in the closer spacing, the slight increases in yield were of doubtful profit.

In planting for nonfood uses the plants should be 2 feet apart in rows 3½ feet apart. Although yields are distinctly lower at 24-inch spacing than at the 12- to 15-inch, the saving in costs of production is greater than the value of the yield lost. Wide spacings give higher proportions of very large roots at harvest. Although this is undesirable in table stock it is no disadvantage in sweetpotatoes for nonfood uses.

## IRRIGATION

In those parts of the West where irrigation is essential to crop production sweetpotatoes are not grown extensively. Methods of growing have not been studied as intensively as for many other crops, and therefore less definite recommendations can be made on how to irrigate sweetpotatoes.

As in the irrigating of other crops, the time and the amount of water applied vary according to the soil and climate. In general, however, on furrow-irrigated lands, six to eight irrigations are applied between transplanting and harvesting. The first irrigation should immediately follow transplanting. Applying too much water after the edible roots have started to form causes them to be poorly shaped and rough, often cracked. Allowing the soil to become too dry between irrigations also may cause excessive cracking. Efforts should be made to maintain a moderate and reasonably uniform moisture content of the soil. The last irrigation should be at such time before harvest that the soil will be in the best working condition during harvest.

Growers of truck crops in the so-called humid parts of the country are rapidly finding it profitable to use supplemental irrigation during dry spells to avoid any serious check in growth and reduction in yield or quality of their crops. Recent experience has shown that the sweetpotato responds very profitably to such supplemental water, usually applied through portable sprinkling systems supplied from streams, ponds, or wells near the fields. At recent high costs for plants, labor,

and other factors of production and relatively high prices for the crop, this method of helping to insure reasonable yields is worth careful consideration in many districts. About an inch of water per acre (an acre-inch is approximately 27,000 gallons) at one or two critical times can very well mean the difference between a poor crop and a good one.

## CULTIVATION

Cultivating serves two purposes: control of weeds and maintenance of ridge height and shape.

Weed control must be practically perfect before the vines become long enough to interfere with cultivation; otherwise the field will become very weedy before harvest. Sweetpotatoes are poor competitors with weeds. Weeds reduce yields and interfere with harvesting. If the field has become weedy before transplanting, it should be thoroughly cultivated immediately after; but preferably it should be kept weed-free from the time the ridges are formed.

### HORSE-DRAWN TOOLS

If the soil tends to form a crust, this can be effectively broken up by a one-horse rotary hoe that has been modified to work two ridges. The standard rotary hoe is not suitable. The modified rotary hoe can be used even after transplanting if the plants are small and a good job of transplanting has been done. One man and mule with this tool can cultivate the tops of ridges on as much as 20 acres per day.

Cultivation between the ridges may first consist of working with a spring-tooth or similar cultivator that partly tears down the sides of the ridges, covering and tearing out weeds both on the sides of the ridges and in the furrows. Later cultivations are largely with sweeps that work the soil back up onto the ridges as they destroy weeds. These one-horse implements are all extremely wasteful of manpower although good work can be done with them by experienced hands.

The two-horse riding cultivator that straddles the row is much more efficient than one-horse tools. The gangs are equipped with either multiple shovels or disks as may be desired, are adjustable as to angle and level, and are controlled both by the driving and by the driver's feet. Experienced workers can handle any of these horse-drawn implements under good field conditions in such a manner that practically all weeds are killed by being either uprooted or covered with soil. If handled properly at the right time, tools of this type can do such a clean job that hand-hoeing is rarely necessary.

The few weeds missed by the implements should be hoed out or pulled by hand.

### TRACTOR TOOLS

Effective cultivation and ridge maintenance with tractor tools demand that ridge construction and transplanting shall have been done in a regular and precise manner. Precision is especially necessary for two-row equipment or larger. Tractor tools are so mounted that when the tractor is in motion the principal control lies only in the driving of the tractor. Variations in distances between rows, wavering of the row on the ridge, and variations in ridge height seriously interfere with doing a satisfactory job. Tractor tools are not flexible enough to deal with such irregularities. The low-wheeled tractor is at a

disadvantage with high ridges, but the high-wheeled type encounters no serious problem.

Each design of tractor and of the tools used with it presents a separate problem that must be worked out according to the particular field conditions and the job to be done. Until one has had considerable experience with power equipment, guidance should be sought from experienced neighbors or other competent local advisors. It is not feasible to try to deal here with the innumerable combinations of equipment and situations that will be encountered on tens of thousands of farms. Nevertheless, modern general-purpose tractors and the tools designed for them are excellently adapted for cultivation of sweetpotatoes as well as other field operations in growing them.

Some common cultivating tools for use on tractors are not suitable for use with sweetpotatoes. Sweeps of the type designed for plow stocks, however, are adaptable and are often mounted to follow disk hillers. The disks are set to cut away part of the ridge and throw the weeds into the middle. The sweeps immediately follow, restoring the soil to the ridge and weeding the upper part of the ridge at the same time. By trial and adjustment and by careful control of tractor speed very accurate work can be done. No more hand-hoeing or weeding should be necessary than following the use of horse-drawn equipment.

## HARVESTING

The sweetpotato root has a delicate skin that is very easily broken. The flesh also is easily bruised, broken, or cut. Wounds are followed by decay unless they are promptly healed before infection occurs. Furthermore, if the root is allowed to become chilled either before harvest in a cold, wet soil or after harvest, the eating quality, storage properties, and value of the root for seed are all damaged.

### TIME OF HARVEST

Over most of the territory where it is grown in this country, the sweetpotato develops a substantial share of its total yield in the last 4 or 5 weeks before frost. Since large yields are necessary, the storage crop is usually allowed to grow as late as possible without its storage quality being injured by cold. It is, therefore, generally recommended that the crop for storage or late marketing be harvested as late as can be safely judged, but before the first frost in autumn. While this rule appears good enough if the sweetpotatoes are to be used for food or feed, recent experiments show that it is not good enough if they are to be used for seed. If the roots are handled carefully and cured and stored properly, harvesting at the time of the first light frost appears to have no bad effect on eating quality or the way they keep in storage. Such roots, however, although perfectly sound and good to eat, have been found to be less productive of plants in the plant bed than roots harvested 2 or 3 weeks earlier. It is probable that the earlier harvested roots are superior because they have not become exposed to temperatures as low as those touching the later harvested roots. Many times it has been demonstrated that allowing sweetpotatoes to become chilled at harvest or in storage even for a short time greatly reduces their sprout-producing capacity.

If an untimely frost or a delay in plans for harvesting causes the leaves to be killed, it is especially important to harvest the crop

promptly. If possible, harvesting should be done when the soil is in good working condition and the weather fair. Harvesting from soils that are too wet causes increased damage to the skins of the roots, causes excessive amounts of soil to be carried into the containers, and makes the roots unattractive and dirty. In unfair weather there is greater danger of the roots becoming chilled than in fair weather. Nevertheless, it is sometimes safer to harvest in cool, cloudy weather than to take the risk of having the unharvested crop encounter worse weather.

A crop for immediate marketing can be harvested at any time that the roots are large enough for sale and that a large enough yield has developed for the crop to be profitable. Early harvested roots are lower in carotene content and in total solids than those harvested just before frost. Harvesting a month earlier than average has about the same effect on yield as planting a month later than average. Profitable yields, even at the temporarily high prices for very early harvests, are not likely to be obtained in less than 100 days from transplanting. In the more northerly districts such early harvesting is uncommon because it is unprofitable. For large yields 130 to 150 days' growth is required.

### HARVESTING EQUIPMENT

Methods of harvesting sweetpotatoes are basically the same as a half century ago. Although those methods may be used a little more effectively now, with more precautions against damage and loss of product, they are laborious and crude. The lack of adequate mechanization of the harvesting contributes to high costs and to the decline in acreage and production of the crop. There is need for power-driven equipment that will get the vines out of the way at harvesttime, remove the roots from the soil, and leave them on top of the row, clean and *undamaged*. Mechanical harvesters tried thus far injure the roots too much.

Sweetpotato vines often are so rank at harvesttime that they interfere with the digging operations. Of the many proposals and devices for dealing with them none is more effective than a shielded 8-inch rolling colter (fig. 11).

A riding cultivator equipped with sharp disk hillers is sometimes used to cut vines on either side of the ridges.

The vines should not be removed from the field, as is sometimes done on small areas, because they are a valuable source of organic matter when worked into the soil. Although the leaves have considerable feeding value, there is now no economical way of removing and using them. Leaf removal much before harvest reduces yields; after leaves are frosted they are unsuitable for feed.

In general, horse-drawn implements for digging sweetpotatoes are less satisfactory than tractor-drawn tools. The average team has too little power for the tools required to do the most efficient job of digging, but the general-purpose tractor has ample power. Ten- and 12-inch moldboard plows are commonly used, but they are inefficient because they are too small to "turn out" the entire ridge of sweetpotatoes at a single trip along the row. Part of one side of the ridge must be first "barred off," with care to avoid going into the ridge so far as to injure many sweetpotatoes. With these smaller plows, 10- or 12-inch, the opposite side may also have to be "barred off" to reduce the size of the

ridge so that it can be turned over at a third trip along the row. Fourteen-inch plows or 12-inch plows with 14- to 16-inch shares bolted on are better than smaller plows, because the row of sweetpotatoes can be uprooted after "barring off" of only one side of the ridge. A powerful team is required with these larger plows.

The colter of walking plows should be lined up with the landside, fixed well out on the beam, and run shallow. Large unshielded colters are not suitable on such plows.

The 16-inch general-purpose tractor plow is perhaps the best implement for digging sweetpotatoes at relatively low cost and with the least damage to the roots. For this purpose the plow must be mounted off center of the tractor so that when the tractor is evenly

*Figure 11.*—**Installing an 8-inch shielded colter of the type recommended for cutting vines when digging sweetpotatoes with a walking plow.**

astride the row the shin of the plow is about 8 inches to one side of the center of the row. Operated in this manner, the plow is forced away from the ridge because there is too little depth of firm soil against the landside of the plow to counteract the great side thrust that comes from uprooting and turning over the entire row of sweetpotatoes. To prevent this side movement and keep the plow under the ridge a large rolling colter is mounted on the plow so that it runs deeply immediately behind and in line with the landside. The shielded colter for cutting vines should be mounted on the tractor rather than on the plow and offset so that it will cut the vines against the firmer soil between the ridges. Two-way tractor plows are also easily adapted to digging sweetpotatoes.

Plows should be run so that the share will pass under the sweetpotatoes deeply enough that few of them will be cut. They should also

be run at a slow, steady speed so that the ridge will be lifted, crushed, and eased over with a minimum of damage to the crop. Trial and readjustments will be necessary to turn out and expose the sweetpotatoes effectively with the least possible injury.

Rod-wing middlebusters and rod-wing plows will get the roots out of the ground, but they often cause much injury to the delicate roots. Sliding rods go under the roots and separate them from the soil, but they break the skin badly and cause too much bruising. Large middlebusters, if carefully operated, cause less injury than the rod-wing implements but are otherwise unsuited to the job. They split the row in two, making difficult the picking up of the roots, and they also leave

*Figure 12.*—**The sweetpotatoes are graded and placed in crates as they are picked up after digging.**

many roots covered with so much soil that they are lost. Small middlebusters are not satisfactory. Conventional potato diggers handle sweetpotatoes much too roughly to be practical.

### PICKING UP SWEETPOTATOES

Until a practical machine is invented that will handle sweetpotatoes "like eggs" in separating them from the vines and soil, the roots should be raked from the soil by human hands and placed in containers. They must not be scratched out with any tools if they are to be stored or marketed. Such removal from the soil scratches and bruises them and causes heavy losses. Some of the best growers require the pickers to wear cotton gloves at this task to prevent the roots being scratched by the fingernails of the workmen as they run their hands through the loose soil to uncover the sweetpotatoes and pick them up.

The roots should not be tossed from one row to another or into containers. To minimize rehandling, each grade should be placed in separate containers as the roots are picked up from the row (fig. 12); all cut, bruised, or defective roots should be kept separate from the sound ones. The need for great care to avoid scratching, cutting, and bruising the roots can hardly be overemphasized. The success of storage and the appearance of the roots on the market depend very largely upon the way they are handled during harvest.

After removal from the soil the sweetpotatoes should be left exposed only long enough for the surface soil on them to dry so that most of it will drop off as they are handled. Contrary to common belief in some districts, longer drying and exposure to the sun are of no benefit, but actually retard the healing of wounds and damage the quality of the roots.

## SELECTING SEED STOCK AT HARVEST

Selection of the roots to be bedded for seed should be done at the time they are harvested. Only at this time can the proper precautions be taken to insure that the roots have come from productive hills that are true to the variety and free from disease. Furthermore, seed stock should have better care than is usually given the bulk of the crop.

It is desirable, if feasible, to grow a separate patch or field especially for seed purposes. Recent experiments also show that roots harvested about 2 weeks before frost are definitely superior for seed purposes to those harvested at or after the first frost. The harmful effect of later harvesting is reduced somewhat if the roots are cured promptly and stored constantly at temperatures of 55° to 60° F.

Seed *must* be selected before frost has injured the main stems of the plants. Before roots are taken from any plant, the stem of the plant should be split with a knife just above the attachment of the roots. If there are any dark-brown or black streaks inside the stem, indicating stem rot, no roots should be kept from that plant for seed. All the sweetpotatoes in each hill should be looked over to insure that they have no diseased spots of any kind. Such spots will carry disease organisms into the plant bed, and these organisms will infect the next crop.

Hills that are much less productive than those nearby should be looked upon with suspicion. Disease is often the cause of such unproductiveness, but not always. Choosing seed stock from only the productive hills, however, helps to avoid disease that is not otherwise evident. The smaller sweetpotatoes (not "strings") from a clean, productive hill are just as valuable for seed as the medium-sized ones and are preferred to the large ones. Large roots produce fewer plants per bushel than medium and small roots.

In order to allow a safe margin for shrinkage and other possible losses in storage and for roots that might have to be discarded because of defects at bedding time, at least 15 bushels of seed stock should be saved for each acre to be planted the following year. Roots of commercial size that are not needed for seed can be disposed of profitably.

Sorting out the smaller and less salable sizes of roots for seed and saving the medium and larger roots for food or other uses is a sound practice *if the seed saving is done as described.* Sorting out seed roots from field-run or commercial lots at the packing house or storage house is a bad practice.

## PREPARATION FOR MARKET

As the consumption of sweetpotatoes has declined in recent years, growers and dealers alike have tried to increase sales by making the commodity more attractive in appearance to the consumer. The sweetpotato is not well adapted to handling by present-day mechanical devices and is ill adapted to rehandling because its skin is easily broken and rot-producing organisms readily attack it. Despite these facts, it is being subjected to an ever-increasing degree of mechanical handling, sorting, repacking, brushing, washing, and even waxing. These measures increase the attractiveness of the roots as they leave the packing house, but the general economic advantage of some of

*Figure 13.*—Sweetpotatoes packed attractively in a paper-lined crate.

them is in doubt. Excessive handling increases the rate of deterioration. Washing is often a hazard, because it may spread rot organisms into fresh cuts or scratches and cause serious losses. Waxing contributes nothing to the keeping or eating quality. Losses in market channels and in the hands of consumers continue to be high. These additional marketing preparations add to the cost of the goods. Higher prices have been paid for them, but the consumption of sweetpotatoes continues to decline.

The sweetpotato is becoming a luxury instead of a staple food in many households. If it is to regain its former importance on American tables, it will be necessary for more growers to produce the crop by the best known methods in order to obtain much larger yields at lower costs per bushel than have been common in recent years. By decreasing the costs of growing and by reducing the handling and

its consequent losses after harvest, growers and others should be able to make an acceptable profit at prices that will encourage consumers to buy sweetpotatoes.

Growers should use the kind of package that is preferred in the area in which they expect their crop to be consumed. The markets of some areas prefer the bushel tub basket; others prefer the straight-sided crate. Purchasers will pay more per bushel for sweetpotatoes that are packed as they prefer. Barrels and hampers are now little used, and bags are definitely unsatisfactory. Jumbo sweetpotatoes are, however, sometimes sent to local or nearby markets in bags for the low-priced trade. Barrels, baskets, and hampers must conform to the standard sizes prescribed by Federal law. The crates in common use are slightly larger than a standard bushel (about 1⅛ bushel) to permit convenient packaging of a minimum weight of 50 pounds of sweetpotatoes after storage (fig. 13).

Although much grading and packing are still done in the field as the roots are picked up from the soil, an increasing amount is done in packing sheds, especially if the roots are to be washed. When the grading is done in the field as the packages are filled, the final facing and closing of the package are usually done at a packing shed.

Grading should conform to the U. S. standard grades. Copies of the specifications of these grades may be obtained from the Production and Marketing Administration, United States Department of Agriculture, Washington 25, D. C.

In general, only grades U. S. No. 1 or better are worth long-distance shipment to market. Shipping and related marketing costs are relatively high. Buyers supplied from a long distance must necessarily pay relatively high prices for their sweetpotatoes and are therefore interested only in high-quality produce.

The No. 2 grade is often worth shipping shorter distances. Some growers and dealers may wish to sell only the higher priced grades. It should be remembered, however, that many prospective customers cannot or should not buy the fancy grades of produce if less expensive grades that will meet their needs more economically are available. It is recognized that the demand for the No. 2 and Jumbo grades may not be great, but efforts should be made to supply that demand.

## CURING AND STORING

Before the sweetpotato can be stored successfully it must be cured. Curing hastens the healing of wounds that are made on the root when it is harvested or handled. Curing involves placing the roots in a room where the temperature is held at about 85° F. and the relative humidity of the air 85 to 90 percent, for 6 to 8 days. For curing to be most effective, the roots must be placed at the proper temperature and humidity immediately after harvest, not a day or two later. Large storage houses in which heat is supplied artificially for curing, should be divided into numerous rooms, each of such size that it can be approximately filled during 1 day's harvest. The temperature and ventilation of each room should be controlled independently so that its contents can be cured promptly at the proper temperature and humidity without overcuring. Artificial heat must be used if necessary to maintain the recommended temperature.

At the end of the curing period the temperature is lowered gradually to 55° to 60° F., where it is maintained for the duration

of storage. There should be no more ventilation than necessary to prevent condensation of moisture on the walls of the house or any of its contents. Humidity should be kept preferably at 80 to 85 percent and no lower than 75 percent.

The sweetpotatoes must be left undisturbed after they are put in the house for curing until they are to be removed. Rehandling will cause new wounds or breaks in the skin through which rot organisms can enter and thereby destroy the benefit of curing.

For further information on curing and storage and on storage structures, see Farmers' Bulletin 1442, Storage of Sweetpotatoes.

Some of the best growers are doing such good jobs of disease control, harvesting, cleaning, grading, packing, curing, and storing sweetpotatoes that the stored packages are sent to market months later with no need for a final sorting. The slack resulting from shrinkage is filled neatly, the package is closed, and that is all. Such success represents the ideal, but it is not impracticable. It does, however, require good equipment, knowledge, experience, competent help, and everlasting attention to details.

## DISEASES

The sweetpotato is subject to injury from a number of diseases that may attack the young plants in the hotbed or the growing crop in the field or cause decay in storage. The worst of these are stem rot, black rot, foot rot, soft rot (ring rot), and, in the Southwest, root rot. Descriptions, illustrations, and control measures are given in Farmers' Bulletin 1059, Sweetpotato Diseases.

The heavy losses from disease and decay now suffered in some sections are in large part avoidable through the methods recommended. Prevention may well begin at harvesttime with the selection of sound, healthy roots to store and to save for seed. Use care in handling to avoid bruises, put no diseased potatoes into storage, and cure and store in suitable houses at the temperatures recommended. It is of fundamental importance to set only healthy plants in the field. Purchased stock should be examined with the utmost care and diseased plants rejected. Those who grow their own plants should follow the directions given on page 21 for disinfecting and sorting the roots planted.

## INSECT ENEMIES

The sweetpotato is not seriously injured by many insects, but the sweetpotato root weevil has been very injurious in sections of the South, especially in the Gulf States. This insect threatens to become a serious menace to sweetpotato growing.

Cutworms frequently destroy the young plants by cutting them off soon after they are set in the field.

For full information on insects affecting the sweetpotato, write to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington 25, D. C.

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